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PRELIMINARY STUDY ON THE USE OF HAND AND HANDPRINT FOR HEIGHT ESTIMATION

NUR ATIRAH GHAZALI, MARDIANA SAAID and KHAIRULMAZIDAH MOHAMED*

Faculty of Applied Sciences, Universiti Teknologi MARA,
40450 Shah Alam, Selangor, Malaysia.
**Email: k.mazidah@salam.uitm.edu.my*

ABSTRACT

Formulation of biological profile is one of the important roles of forensic anthropologist. The choice of methods for hand measurement in height estimation studies among researchers are rather static. There are a few methods that have been used by researchers for handprints collection. It ranges from the conventional method of using ink or paint to the use of electronic scanner. It is somehow debatable on which technique provides the most accurate results and depicts the real situation at a crime scene. This preliminary study was conducted to find out the most suitable method of handprint collection and to determine the most suitable time for height measurement. The data obtained were analyzed using Statistical Package for Social Sciences (SPSS) for its general descriptive statistics and their significant differences of mean comparison, in order to determine the most suitable method and time of collection. The result indicated that the most suitable time of collection is between afternoon and evening while for method of collection, it was concluded that any method employed must be consistent throughout the study.

Key words: forensic, anthropology, height, hand, handprint method development, latent print

INTRODUCTION

Forensic anthropology is the analysis of human remains for the medico-legal purpose to establish the identity of unknown person. Anthropologist is a person who assists in the identification of individuals who are severely disrupted, burned, mutilated, decomposed or is hard to identify. Forensic anthropologist focused more on the development, morphology and variation of human body. There are four basic biological criteria used for identification which are skeletal or development age, sex, living stature and ancestry or racial affiliation (Jamieson & Moensson, 2009). Anthropometry is the measurement of the size and proportion of human body in which the ratios of body weight to height can be used to represent body proportion (Pikonkova, 2012). This system is important for identification of human remains as an essential element in medico-legal investigations. Forensic anthropometry has been widely used in forensic field since it was first introduced by Alphonse Bertillon in 1879. He had invented a systematic procedure by taking a series of body measurements as a means of distinguishing one individual from another (Saferstein, 2007). Stature estimation is considered as one of the parameters in biological profile for personal identification. It can provide useful information regarding the identity of unknown human remains which helps to narrow down the number of possible matching identities for investigating authorities. There are several studies that have been undertaken for stature (Krishan & Sharma, 2007; Rastogi *et al*., 2008; Ishak *et al*., 2012a; Khairulmazidah *et al*., 2013; Nataraja *et al*., 2014) and sex estimation (Ishak *et al*., 2012b; Galeta *et al*., 2014) which related to medico-legal and forensic purposes. These studies are important because every human body part has more or less constant relationship with stature. This is useful when an individual hand or foot being recovered can provide valuable information for the person's identity (Sen *et al*., 2014). Anthropometry also has potential utility in scenarios that involve dismemberment of the body due to airplane crash, accidents or explosions. There are three methods of handprints collection used in this study which are paint, scanner and magnetic powder. These methods will be compared in order to get the most accurate result and represent the real situation at the crime scene. The aims of the current study are to determine the most suitable time for height measurement and

* To whom correspondence should be addressed.

to find out the most suitable method for handprints collection.

MATERIALS AND METHODS

Anthropometric measurements

Four volunteers were randomly selected for height and hand measurements. The stature measurements were recorded using a portable stadiometer whereas hand measurements were taken using digital calliper. In order to find the most suitable time, all the measurements of height and hand were taken three times a day; morning, afternoon and evening for three days. The data collected from the measurements were then analyzed by Statistical Package for Social Sciences (SPSS) for comparison of means.

Collection of handprints

For the first method, paint or water colour was applied to both palm; left and right. After that, both hands were pat onto a drawing book as shown in Fig. 1(a). A total number of nine handprints using this method were produced from each volunteer. For the second method, a scanner (HP Deskjet Ink Adv 2060 K110) was used to obtain the images (200 dpi) of the hands and then converted to handprints. The same person was asked to produce these handprints with a total number of nine handprints. The handprint images were then measured and analyzed using ImageJ software as shown in Fig. 1(b). And the last method is producing handprints using magnetic powder. First, a few drops of baby oil was smeared throughout the palm and fingers region of their hands and then each of the volunteer was asked to pat their hands onto an A4 paper. Next, magnetic powder was applied on the latent prints as the development technique. The image of an example of handprint produced using this method is shown in Fig. 1(c). The handprint is then covered with plastic laminate and kept for further analysis. The same total number of nine handprints was developed for this purpose for each of the volunteers. Both methods using paint and magnetic powder were measured using digital calliper. Finally, all the data were analysed for significance difference of mean comparison using Statistical Package for Social Science (SPSS).

RESULTS AND DISCUSSION

Descriptive statistics

The descriptive statistics showed that the mean for height measurement is 151 cm. The total number for stature measurements are twelve from four persons in three days. The mean, standard deviation, minimum and maximum value for height measurement in three different parts of the day are shown in Table 1.

To compare means, paired sample t-test was used to find out whether there is significant different between the three time slots. From the result (Table 2), we can see that from morning to afternoon and morning to evening, there is a significance difference which indicates the means are equal whereas for afternoon to evening, there is no significant difference.

Besides, the analysis from hand measurements also showed that there is not much significance between those times. Only right handbreadth, left palm length and left hand length gives significant difference in their measurements done in the morning compared to afternoon. Since height measurements done in the mornings have significant different to height measure during afternoon and evening, it is imperative to suggest that the best time for taking hand measurement as well as handprint is between afternoons to evening. Apart from that, there is no significant different in all types of hand measurements when compared between afternoon and evening. Height measurements taken in the morning is taller than height measurements taken during afternoon and evening.

Table 3 shows the results of mean comparison of handprint measurements between three different methods of handprint collection. The results indicated that the index length and hand breadth gave significant difference for both right and left

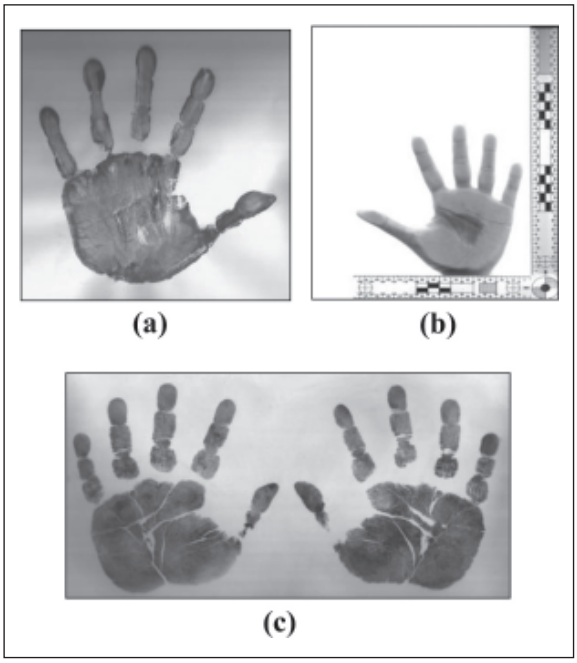

Fig. 1. (a) The handprint image of the paint; (b) The handprint image of the scanner; (c) The developed handprint image using magnetic powder.

Table 1. Descriptive statistics for height measurements

	Minimum	Maximum	Mean	Standard deviation
Height (morning)	146.100	155.500	151.408	3.631
Height (afternoon)	145.400	155.300	150.667	3.627
Height (evening)	145.500	155.000	150.633	3.634

Table 2. Paired sample t-test for height measurement in three times

Time	Sig. (2-tailed)
Morning to afternoon	0.000
Morning to evening	0.000
Afternoon to evening	0.777

Table 3. Analysis of methods by One-Way ANOVA for both right and left handprint

Type	Handprint	
	Right	Left
Index	0.000	0.000
Middle	0.085	0.676
Ring	0.293	0.469
Pinky	0.138	0.481
Thumb	0.852	0.000
Hand breadth	0.000	0.000
Palm length	0.268	0.155
Hand length	0.013	0.217

Table 4. Paired sample t-test for three type of methods

Type	Method	Handprint	
		Right	Left
Index	Paint-scan	0.000	0.000
	Paint-magnetic	0.336	0.255
	Scan-magnetic	0.000	0.003
Thumb	Paint-scan	0.611	0.003
	Paint-magnetic	0.699	0.828
	Scan-magnetic	0.979	0.000
Hand breadth	Paint-scan	0.001	0.001
	Paint-magnetic	0.000	0.307
	Scan-magnetic	0.001	0.000
Hand length	Paint-scan	0.811	0.042
	Paint-magnetic	0.029	0.236
	Scan-magnetic	0.019	0.417

hand. In comparison, hand length gave significant difference for right hand and thumb and showed significant difference for left hand. Table 3 and Table 4 confirm that only four type of handprints showed the significant difference in terms of length. Following that, paired sample analysis were conducted to the Index length, Thumb length, Hand breadth and Hand length to further classify methods that contribute to the significant difference.

Table 4 shows the analysis of mean handprint measurements from three different methods for both right and left hand, using SPSS. Handprint collection using a scanner has significant difference when compared with the other two methods. This indicates that, this method is better compared to methods using magnetic powder and paint. Besides, the calculation of the standard error for these methods showed that the standard error of scanning method is lowest followed by magnetic powder and paint. Moreover, , the image of handprint shown by scanning method (Fig. 1(b) looks similar to hand itself which is very clear instead of print whereas the image from magnetic powder is similar to the one recovered at the crime scene. There is almost always a certain part of the handprint which is not complete especially the part between fingers and the palm. Although scan method of sample collection might give a better standard error of estimates, the trouble of getting electric source while collecting sample apart from the image produced, gives more credit to sample collection using magnetic powder method. This method would depict the real situation at a crime scene.

CONCLUSIONS

The study suggests that the best time for stature measurement is between afternoon and evening while the most suitable method for handprints collection is magnetic powder. However, most of the handprint measurements done in this study showed that there is no significant difference among all three type of methods. Therefore, any methods employed have the same chance in producing good result

provided that it is consistent throughout the investigation. Result from this preliminary study will be used for further analysis in stature estimation regarding hand and handprint measurements for forensic purpose.

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